Regional Innovation Systems within transitional context: Evolutionary comparison of electronics industry in Shenzhen and Dongguan since opening in China

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Abstract: Governance constitutes elementary supportive infrastructure for regional innovation systems. This paper extends the evolutionary lens of governance into initial industrialization phase and examines the impact of their evolution into regional innovation systems on fostering innovation activities within China's transitional context. Drawing on the empirical substances in Shenzhen and Dongguan, China, a path-dependent nature of governance modality to initiate industrialization within the transitional context has been discovered. The paper shows that the dirigiste globalized production system in Shenzhen in 1980s has gradually evolved to a higher level of interactive regional innovation system than the grassroots globalized production system in Dongguan, where innovation activities are low and are still passively managed by global players. The review on the evolutionary path of electronics industry in Shenzhen and Dongguan revealed that the locational first-mover advantage in Shenzhen is further strengthened by the institutional first-mover advantage, incubating

competitive and diversified firms in the business sector that enables the interactive learning mechanism in a regional innovation system. Finally, policy implication is discussed for the construction of regional innovation systems under different governance modalities in the initial industrialization phase.

Keywords: Regional Innovation Systems; Evolution; Governance; Dirigiste; Grassroots

1. Introduction

In a globalizing world, economic growth is increasingly intertwined within complex international interdependent networks. Since 1970s, Asian countries picked up more significant growth rate than other developing countries by actively involved in global production network. In this context, threats and opportunities exist simultaneously for the emerging economies. Altenburg (2006) argued that the limited resources in qualified personnel, competitive and diversified firms and effective institutions in the Asian emerging economies might cut them off from the knowledge-based competition on increasing return generated innovation. Park (2003), on the other hand, pointed out that some innovation clusters are emerging in the Asian Pacific Rim and successful regional innovation systems (RIS) can be developed through policy initiatives in these clusters.

There are two central elements of a regional innovation system. The first one is the willingness and capacity of firms to undertake innovation as well as interactive learning with other firms and institutions, and the second one is the initiative of policy maker to promote innovation and interactive learning by establishing supportive infrastructure and institutions (Asheim and Coenen, 2005; Cooke et al., 1997; Howells, 1999; Morgan,

2004; Revilla Diez, 2002). Apart from these two elements, regional innovation systems can bear different forms (Braczyk et al., 1998). While the RIS in developed regions such as Silicon Valley and Germany's Baden Württemberg Region base on cutting-edge technological innovation, RIS in Asian emerging economies might be based more upon external technology and incremental innovation.

Governance, including institutions and organizations, are considered as the fundamental infrastructure of a regional innovation system, as they are able to facilitate interaction and cooperation. Meanwhile, institutional reform has been found to be the catalyst of rapid industrialization and economic development in many Asian countries (Lundvall et al., 2006; Goldsmith, 2007). In China, the plan-economy has been transiting to a market-economy in an incremental way, releasing the growth potential that was locked by the old ill-incentivized institutional design. For regional development, Chinese central government has either been directly involved in economic development, such as establishing economic special zones, or has implicitly encouraged the bottom-up development, mainly by allowing more economic developmental autonomy to local governments. Therefore, the uniqueness of China's transitional context must be foregrounded in the investigation into the development of regional innovation systems in China.

In this paper, we show how the formation of a regional innovation system unfolds itself under these two distinct institutional designs and governance modality to initiate industrialization following the introduction of the opening policy in China. The two cities are Shenzhen and Dongguan located in the South-east Province Guangdong in China. In Shenzhen, especially in the Special Economic Zone (SEZ), the governance supporting industrialization is rather dirigiste, characterized by a state-oriented involvement of economic development with active strategic policy support. In

Dongugan, however, governance that supports industrialization is grassroots, characterized by flexible institutions organized mainly by town and village authorities that are favorable for overseas Chinese investment based on Guanxi (Leung, 1993; Yang, 2010).

The remainder of the paper is organized as follows. Based on the theoretical discussion on the regional governance modality developed by Cooke et al.(1997) and its extended implication within China's transitional context, the third part examines the willingness and capacity of firms to undertake innovation and interactive learning in Shenzhen and Dongguan on the basis of an electronics firm survey conducted in 2009. The fourth part tries to explain the divergent innovation pattern in the two cities by investigating the governance modality in Shenzhen and Dongguan in the initial industrialization phase and the transitional phase, focusing on the path-dependent character of the governance evolution in the two cities and its impact on innovation and the related actor interactive learning. Finally, the paper concludes and discusses the policy implications derived from the cases in Shenzhen and Dongguan.

2. Evolving Governance and Innovation: Discussion within China's Transitional Context

Due to the transitional context the evolution of the production system can be observed after the opening policy. In China, the production system in the initial industrialization phase is dominated by global corporations with a clustered supply chain of dependent SMEs. The governance is mostly characterized by the formulation of favorable policies such as tax reduction and the support of hard and soft infrastructure to foreign firms' processing functions driven by local government's incentive to raise the fiscal income. What is more, since the advent of the opening policy in the late 1970s, the Chinese central government has either been directly

involved in economic development, such as establishing economic special zones, or has implicitly encouraged the bottom-up development, mainly by releasing more economic developmental autonomy to local governments. Therefore in the initial industrialization phase in China, grassroots globalized production systems and dirigiste globalized production systems can be distinguished as two major forms of territorial production systems.

In the grassroots globalized production system, the degree of supra-local co-ordination is low because of the localized nature of organization and the funding comprises a mix of capital, grants and loans mainly from local banks, local government and possibly the local Chamber of Commerce. In the dirigiste globalized production system, on the other hand, initiation industrialization processes are a product of central government policies, leading to a high degree of coordination. Moreover, funding in dirigiste modality is largely centrally determined, although the agencies may have decentralized locations in the regions (Braczyk et al., 1998).

When the spatially specialized entity evolves into an innovation system in the face of external pressure, the governance should in theory co-evolve and adjust the focus to supporting innovation activities. To secure systematic learning and innovation synergies that occur externally of the firm boundary, governance plays an important role in providing access to information, ensuring credibility, coordinating collective actions and even creating a learning atmosphere (Amin, 1999; Dalum et al., 1992; Haggard, 2004). Cooke et al. (1997) outline the governance dimension in regional innovation systems as follows (Table 1): 1) Institutional competence to organize technology transfer and launch science and technology programs; 2) Supported infrastructure to enhance the capacity of innovation and extend the scope of interactive

learning; 3) Financial and budgetary capacity to reduce innovation-related uncertainty and risk as well as mobilize innovation-related resources.

Table 1 Governance Content in Production Systems and Innovation Systems

	Production Systems	Innovation Systems
Institutional competence	Capacity to design and execute industrial development policies	Capacity to organize technology transfer (local, regional, …) science and technology program
Supported infrastructure	Hard infrastructure such as roads, electricity, port, etc.	Density and quality of infrastructures for innovation such as universities, research institutes, technology transfer agencies, consultants and skill-development and training agencies
	Soft infrastructure such as administrative services to assist the firms	Control or shared execution of part of strategic infrastructures
Financing & Budget	Capacity to impose taxes	Accessibility of capital market for firms
	Autonomy for public spending	High level of financial intermediaries

Source: Adjusted from COOKE *et al*. (1997)

From an evolutionary perspective, the initial governance modality in the industrialization phase place significant influence on the successful transformation of simple-production-supported governance to innovation-supported governance. Moreover, the transition to market economy even plays a more important role in the evolving governance than external market conditions for stimulating the adjustment of the governance that release the innovation potential such as entrepreneurial activity. Moreover, new organizations from the reform are somewhat "sticky" in the place, giving first-mover advantage to the places they originally emerge.

To be more specific, two aspects of governance are used to elucidate the evolutionary character, i.e. the competence of organizations and institutional advantage (Cooke et al., 1998).

Firstly, the dynamics of the governance evolution towards becoming innovation-supported depends on the competence of the involving organization. In the initial industrialization phase, when the industrial base is weak, the perspective of resource endowments of related organizations becomes an important baseline for the

evolution of governance towards a well-functioning innovation system. In Porter's (1998) competitive model, local endowments such as highly specialized skills and knowledge, institutions, related businesses and demanding customers are emphasized for the construction of a competitive cluster. For a grassroots globalized production system, production capital and know-how depends heavily on foreign investment. There is no skill base in the production system either from previous accumulation or assignments from the central, enabling the absorption of foreign technology. In contrast, the dirigiste globalized production system is able to accumulate the skill and knowledge stock from the old national knowledge system such as relocation of large state-owned firms and research institutes. In a word, the original players in the initial industrialization phase in the two different systems define the capacity of localities to process, absorb and adapt the external technology (Cohen and Levinthal, 1990; Zahra and George, 2002), and this further forms an irreversible cycle, in which higher level of foreign investment is attracted and higher competence of organizations are generated due to the higher level of technological spillover.

Secondly, the dirigiste governance outperforms the grassroots governance in terms of institutional advantage in two aspects. The first aspect is the higher degree of policy coordination in the dirigiste governance, thereby focusing on selected long-term trajectories and developing a level of consensus on desirable futures. The coordinated policy action includes the practice of identifying new strategic industries, creating partnerships between sciences, industry and government, as well as providing incentives for multidisciplinary research along a specific development direction. The second aspect is that the dirigiste approach, which is mostly initiated and governed by national level agencies with more power, is more able to act as the vanguard of reform and enjoy the privilege of first-mover advantage. The establishment of stock exchange

market is one of the examples of such reforms. It is able to stimulate local technological entrepreneurship and support innovation activities of private firms, giving the places first-mover advantage in developing innovation-related capabilities.

However, it should be mentioned that both the two aspects of institutional advantage of the dirigiste globalized production system over the grassroots approach depend on the capacity of the central government in question. Overall, it is still insecure to leave the future of development in the hands of central authorities. Firstly, there might be misinvestment in the selection of key industries when little information is collected from the market, generating opportunity costs for the locality. Secondly, soft budget constraints are most likely to occur in state-owned firms, which play an important role in the dirigiste approach, causing lower efficiency and poorer performance than in private sectors (Qian and Roland, 1998). Therefore, dirigiste modalities must gradually involve more market mechanisms of competition in the transitional process. In addition, the participation of market power incentivizes the exploitation of entrepreneurial activities on the stock of technological knowledge in the previous dirigiste production systems. In this way, more competitive and diversified firms can be fostered, enabling the firms in the places to undertake interactive learning to gain innovation ideas and support.

On the other hand, the evolution of grassroots governance from a production system to an innovation system carries more inertia than the dirigiste one. As argued by Easterly (2008), the grassroots approach evolves gradually within the constraint of previous institutions, while the dirigiste approach is able to start with a blank sheet or tear up the old institutional setup. This argument has two implications. Firstly, while the dirigiste governance enjoys the institutional advantage, a “competency trap” might arise in grassroots governance, as being too good at something constrains the capacity

of grassroots organizations to absorb new ideas and develop new trajectories (Levitt and March, 1988). In the light of this, a mixed level of organizations should be in place to ensure breaking through the "sticky knowledge" and forming new competencies. Secondly, vested interests in organizations tend to emerge in the evolving process of grassroots governance, which might oppose the changes that undermines their current gains and positions (Boschma, 2004). Altogether, it constitutes "cognitively sunk cost" and "motivational sunk cost", (Leonard, 1992), creating systemic market and policy barriers to interactive business innovation as new development alternatives unfold (Könnölä et al., 2006).

Using Lundvall et al. (2006)'s argument as conclusion, neither over-centralized systems that leave no autonomy at lower-level policy learning nor decentralized ones that lack the central governance mechanism necessary to initiate radical change will be able to cope with the challenge of industrial upgrading. In a word, governance of a regional innovation system should involve both free market power and central government intervention on institutional reforms.

The theoretical overview on the evolving nature of the governance modality within the transitional context discussed above provides the starting point for investigating its impact on business innovation activities. The comparison of the Shenzhen and Dongguan cases should reveal a different pattern of interactive learning and systemic innovation, providing a divergent evolving path of governance modality as shown by the following section.

3. Innovation Pattern in Shenzhen and Dongguan: Empirical Evidence

3.1 Survey Design of A Comparative Study

The comparative study has been identified by many scholars, for example Staber (2001), Doloreux (2004) and Asheim and Coenen (2005), as the most important means

of fully understanding the function of RIS and capturing hidden variables that are of interest to the construction of RIS. Therefore, comparing the evolution of the regional innovation systems in Shenzhen and Dongguan, both are located in the prosperous Pearl River Delta in Guangdong Province, China, offers a unique perspective for understanding the specific contents of governance modality that influence the systemic innovation in the region.

The empirical data were collected from an electronics firm questionnaire survey in Shenzhen and Dongguan, Guangdong Province, China. The investigation focuses on the electronics industry because of its great dominance and development history in the research area, which enables the inquiry into its evolutionary path. As shown in figure 1, the output value of the electronics industry in Shenzhen and Dongguan kept growing during the period between 1994 and 2009. Dongguan, which is known as the "world factory of electronics", experienced a much lower level of output value growth than Shenzhen due to the concentration of low-value processing.

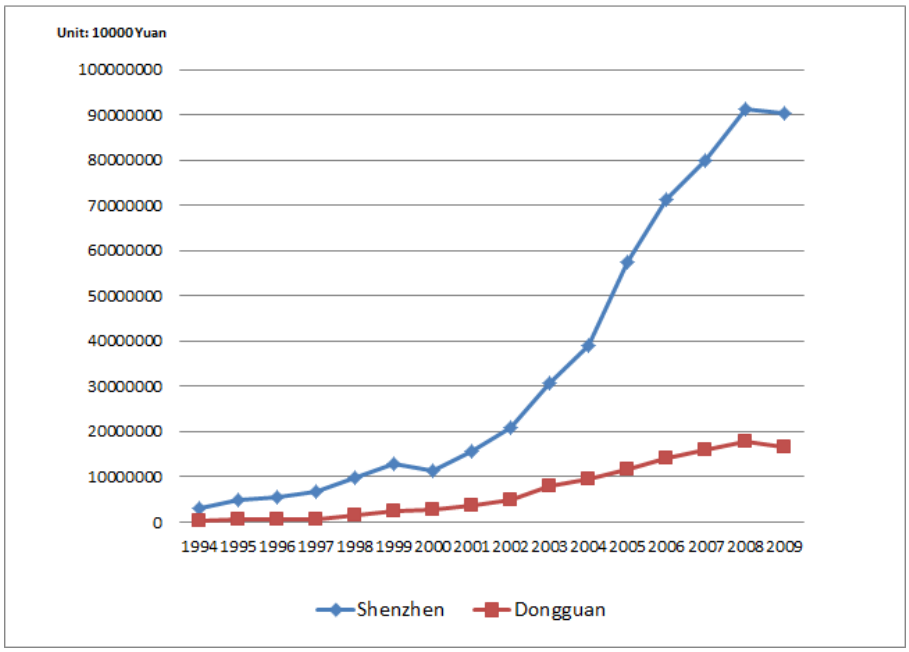

Figure 1 Output Value of the Electronics Industry 1994-2009

Source: Shenzhen Statistical Yearbooks and Dongguan Statistical Yearbooks

The questionnaire survey was conducted via telephone and mail in order to ensure the feasibility of the survey and validity of the data, and was strengthened by following-up that aimed to persuade the firms to fill out and send back the questionnaires, as well as to fill out unanswered questions after the questionnaires were returned. Additionally, in order to establish contact with more firms, a second approach was applied, namely visiting fairs. The fairs and firms visited were randomly selected. Moreover, the fairs visited have a large number of firm exhibitors, ensuring the unbiased nature of the fair-visiting result. In total, 312 Shenzhen firms and 281 Dongguan firms were contacted. In total, 167 Shenzhen firms and 177 Dongguan firms filled out the questionnaires, with the response rate in Shenzhen and Dongguan being 54% and 63% respectively.

In the sample, there are 140 Shenzhen firms and 161 Dongguan firms that undertake product innovation activities. The core innovation questions cover the internal efforts and external interaction during the innovation process, i.e. acquiring new innovative ideas, acquiring codified knowledge and tacit knowledge. The scope of external interaction covers various business partners, such as parent companies, foreign customers, domestic customers, universities and research institutions, as well as sales agents. In addition, the interaction mode with the partners is identified, i.e. interacting with the partners through active search strategies such as the Internet, exhibitions or sales agents, and interacting with the partners through the introduction and recommendation of long-term business partners, relatives and friends. Surveyed firms were asked as to the importance of each aspect in product innovation activities.

3.2 Empirical Results of Innovation and Interactive Learning in Shenzhen and Dongguan

In this part, an empirical investigation into the scope and extent of interactive learning and systemic innovation in the electronics industry in Shenzhen and Dongguan was conducted in order to gain insights into the respective regional innovation systems. Before that, the general regional indicators in both cities are shown in Table 2.

The pattern of specialization in high-tech sector in Shenzhen outstands from that in Dongguan in terms of industrial output value and employment. Moreover, Shenzhen's total R&D expenditure and R&D outperforms Dongguan both in absolute and relative term, which all point to a higher level of innovation resources and human capital that enables the well-functioning of a regional innovation system.

Table 2 General Indicators in Shenzhen and Dongguan (2009)

	Shenzhen	Dongguan
Population	8912,300	6350,000
Gross Domestic Product (billion Yuan)	820	376
Industrial Output Value (billion Yuan)	1582	676
% of High-tech manufacturing sector[1]	69%	39%
Employment	6924,853	5381,981
% of High-tech manufacturing and service sector[2]	33%	19%
Total R&D expenditures (billion Yuan)	27.97	4.14
% of GDP	3.4%	1.1%
R&D personnel	123687	18524
share of R&D personnel per 1000 employees	17.9	3.4

1. High-tech manufacturing sector refers to ordinary equipment, special purpose equipment, transport equipment, electric equipment and machinery, telecommunications, computer and other electronic equipment (only state-owned firms and firm with over five million sales are calculated).
2. High-tech manufacturing and service sector include the high-tech manufacturing sector above and service sector, i.e. information transfer, computer and software services, scientific research, technical services and geographical prospecting.

Sources: Shenzhen Statistical Yearbook 2010, Dongguan Statistical Yearbook 2010 and 2nd Investigation Report of Guangdong R&D Resources

In the econometric analysis, tobit regression was applied to examine the impact of external interaction with other business partners on firms' innovation outcomes. The dependent variable in the regression is the average score of evaluation of the degree of improvement (ranging from 0 to 5 with increasing significance of change) on function expansion and categories upgrading. Due to the censoring of the valuation towards higher rank, tobit regression was run. Factor analysis was firstly applied to reduce the

dimensions of independent variables in order to simplify the following regression. The derived factors are able to explain over 60% of the variance of the original sample. In order to avoid multicollinearity, seven variables were finally selected as the independent variables. Table 3 shows the independent variables, including the innovation behavior mainly investigated and other control variables.

Table 3 Independent variables in Product Innovation Performance Regressions

	Indicators	Description
Innovation Behavior	NPI_external partners	Interacting with *domestic customers, universities, research institutions and sales agents* to gain innovation ideas
	NPI_internal efforts	Making *internal learning efforts* such as own ideas, license purchasing and reverse engineering
	NPI_parent comp. & foreign	Relying on parent companies or foreign customers to gain innovation ideas
	NPTK_active learning	Sending staff *to business partners* for training
	NPTK_passive from customer	Receiving training and know-how from people sent *by domestic and foreign customers*
	NPTK_passive from parent comp.	Receiving training and know-how from people sent *by parent company*
	NPInteraction _informal	Interacting with innovation partners *within Guanxi networks*
Firm Characteristics	Size	Defined according to Chinese firm size standard, 1 as large firms with sales no less 300 million Yuan and no less than 2000 employee, otherwise as small and medium-sized with the value of 0
	Ownership	1 as firms with foreign participation (wholly owned or joint venture), 0 as firms with 100% domestic participation
	Age	Years since establishment of the firm
Absorptive Capacity	Educational level of technical staff	Proportion of technical staff with bachelor degree and above
	Initial technological level of main product	Defined according to International Standard Industrial Classification of all Economic Activities, Rev 3, 1 as producing low-tech products when starting business, 2 as producing medium-tech products when starting business; 3 as producing high-tech products when starting business

Table 4 gives the descriptive statistics for the variables and tests the variation level between Shenzhen and Dongguan. In the surveyed sample, most of the firms are small and medium-sized. The share of domestic firms in Dongguan is less than that in Shenzhen to a significant degree. Technical staff possesses significantly higher

absorptive capacity in Shenzhen than that in Dongguan according to the share of above bachelor degree technicians, and Shenzhen firms also start with higher production technology than Dongguan. In terms of innovation behavior, Shenzhen firms turn more to external partners in triggering innovative ideas than Dongguan firms, but not at a significant level. On the other hand, Dongguan firms rely more on the transfer of tacit knowledge from parent companies and foreign customers, and more frequently use informal relations with friends and business partners.

Table 4 Descriptive Statistics in Shenzhen and Dongguan

	Shenzhen				**Dongguan**				***ANOVA***	
	Mean	S.D.	Min.	Max.	Mean	S.D.	Min.	Max.	*F*	*Sig.*
Firm Size (% of large firms)	0.06	0.23	0	1	0.11	0.31	0	1	2.255	0.134
Firm Ownership (% of foreign firms)	0.28	0.45	0	1	0.47	0.50	0	1	11.95	0.001
Firm Age (years)	10.4	7.6	1	57	12.2	7.1	2	51	4.30	0.039
Educational level of technical staff (%)	0.43	0.36	0	1	0.33	0.30	0	1	5.72	0.017
Initial technological level of main product	1.99	0.63	1	3	1.78	0.64	1	3	7.93	0.005
NPI_external partners	0.10	1.05	-2.05	2.53	-0.07	0.96	-2.78	1.69	2.24	0.135
NPI_internal efforts	0.02	0.89	-2.67	1.68	0.11	1.06	-2.61	7.43	0.63	0.427
NPI_parent comp. & foreign	-0.22	0.87	-1.81	2.22	0.27	1.04	-2.89	2.90	19.19	0.000
NPTK_active learning	-0.03	1.01	-2.10	2.57	0.06	0.95	-2.19	2.10	0.68	0.409
NPTK_passive from customer	-0.02	0.94	-1.95	2.08	0.10	1.04	-2.13	2.27	1.03	0.31
NPTK_passive from parent comp.	-0.04	0.98	-1.38	3.28	0.10	1.02	-1.38	3.21	1.40	0.238
NPInteraction informal	-0.14	0.95	-2.52	1.60	0.14	1.03	-2.53	1.60	6.13	0.014

Table 5 shows the result of the tobit regression on product innovation performance. Three models are run as a comparison: whole model pooling of the Shenzhen and Dongguan data, the Shenzhen model and the Dongguan model. All the models fit significantly better than an empty model, which is indicated by the significant level of the chi-square likelihood ratio. The whole model serves as an intermediate between the

Shenzhen model and the Dongguan model, which reflects the difference between Shenzhen and Dongguan in a clearer way.

Table 5 Tobit Regression on innovation performance

Independent variables		*Product Innovation outcome*		
		Whole Model	**Shenzhen Model**	**Dongguan Model**
Constant		3.56***	3.38***	3.70***
		(0.192)[1]	(0.289)	(0.239)
Educational Level of Technical Staff		0.004*	0.005	0.002
		(0.002)	(0.003)	(0.003)
Ownership		-0.30*	-0.53*	-0.05
		(0.153)	(0.268)	(0.206)
Firm Size		0.23	0.32	0.15
		(0.276)	(0.522)	(0.305)
Firm Age		0.008	0.03*	-0.008
		(0.010)	(0.015)	(0.013)
Initial Product Type according to technology	Medium tech vs. low tech[2]	0.15	0.08	0.16
		(0.168)	(0.282)	(0.191)
	High tech vs. low tech[2]	0.37	0.14	0.60**
		(0.237)	(0.357)	(0.302)
NPI_external partners		0.31***	0.53***	0.12
		(0.091)	(0.158)	(0.105)
NPI_internal efforts		0.20**	0.39***	0.05
		(0.081)	(0.135)	(0.093)
NPI_parent comp. & foreign		0.25***	0.21	0.25**
		(0.089)	(0.155)	(0.102)
NPTK_active learning		-0.05	-0.28*	0.08
		(0.094)	(0.147)	(0.118)
NPTK_passive from customer		-0.07	-0.43***	0.16
		(0.087)	(0.135)	(0.103)
NPTK_passive from parent comp.		-0.08	-0.11	-0.12
		(0.082)	(0.133)	(0.098)
NPInteraction_informal		-0.04	0.04	-0.07
		(0.083)	(0.140)	(0.098)
Prob > F		0.0005	0.0006	0.0291
Prob > R2		0.05	0.11	0.07
Number of Observations		240	109	130

1. Standard errors in parentheses; *p<0.10, **p<0.05, ***p<0.01.

2. Initial product as low-tech as the default group, which means low-tech as 0, the others as 1;

Observing firstly the variables indicating the behavior in the various stages of the product innovation process, Shenzhen firms combine their internal absorptive capacity with external interaction with other partners to trigger innovation ideas, which eventually boosts the innovation outcomes. In a regional innovation system, the

interactive learning not only contributes to effective knowledge transfer, but also triggers the innovation, enabling capitalization on new creative resources from the complementary knowledge of various players in the cluster (Capello, 1999). Although many empirical studies indicated limited R&D activities and low-level inter-firm knowledge spillover based on patent data and formal R&D cooperation (Wang and Lin, 2008; Yu et al., 2011), this analysis indicates the shaping strategy and capacity of Shenzhen electronics firms to capitalize on wider sources of knowledge spillovers, including domestic customers, sales agents, universities and research institutes, to foster the product innovation outcome.

On the other hand, innovation ideas originating within strict hierarchical organizations, i.e. instructions from parent companies and foreign customers, boosts innovation outcome for Dongguan firms. Interactive learning in Dongguan is exclusively oriented to a fairly passive pattern of receiving orders to expand product functions and upgrade product categories from the organizationally proximate partners. Compared to the innovation activities in Shenzhen firms, the role of organizational proximate partners in promoting innovation is also smaller (0.25 compared to 0.53). The limited capacity for drawing upon a wider scope of external sources to foster innovation reflects the bottleneck of upgrading in Dongguan, where the internal absorptive capacity and external business environment do not permit the strategic use of interactive learning in the innovation process.

Moreover, the difference of the control variables confirms the hypotheses from another point. For Shenzhen firms in the sample, older firms tend to have higher performance in product innovation. This variable demonstrates the long history of capability accumulation related to innovation activities, such as in technological development, management optimization and market research, and contributes to higher

absorptive capacity and higher effectiveness in bringing out better innovation results. In contrast, the small insignificant impact of firm age on innovation performance for Dongguan firms indicates that the firm strategy for accumulating technological and managerial capabilities around innovation activities is not conscious and systematic. However, Dongguan firms producing high-tech electronics products at the beginning, which indicates higher absorptive capacity, perform better than firms producing low tech electronics products at the beginning in a significant level of 90%. In short, firms in Dongguan rely more than Shenzhen firms on the routine accumulated gradually within the firm boundary, rather than on complementary knowledge outside the firm, leading to the lack of dynamism and incentive to trigger innovation. The innovation activities in Dongguan are rather passively led by globalized players such as parent companies and foreign firms.

From the empirical analysis of the survey data in Shenzhen and Dongguan, Shenzhen demonstrates a more dynamic innovation pattern, involving active knowledge spillovers among firms. Although Shenzhen is a young city and is still weak in research and education infrastructure, the competitive and diversified business sector has been shaped in the place and enables the exploitation of the specialized electronics-related knowledge stock that generates increasing return to R&D investment.

4 Governance in Shenzhen and Dongguan, China: An Evolutionary Overview

In this part, the evolving governance from a production system to an innovation system in Shenzhen and Dongguan is analyzed, seeking for an explanation to the different innovation pattern revealed above from an evolutionary perspective.

The institutional setups in Shenzhen and Dongguan, Guangdong Province, which have evolved since the opening policy to meet the needs of rapid industrialization, correspond to the dirigiste and grassroots governance modalities respectively. In the following analysis, the evolution process of governance will be summarized by the thorough review of the "Shenzhen Electronics Yearbook" (SECC, 2004) and the "Guangdong Electronics Yearbook" (GECC, 2002). In these two yearbooks, descriptive facts are provided for the developmental path of the electronics industry in Shenzhen and Dongguan. Moreover, an in-depth interview was conducted in late 2007 with the former chair of the Guangdong Electronic Chamber of Commerce (GECC) to gain insight into the industrial development history and changing interests of governments at various levels.

4.1 **Governance Evolution in Shenzhen since the opening policy**

4.1.1 Governance in the initial phase of industrialization in 1980s

Shenzhen was a small, peripheral town before 1978. In 1979, it was selected by the central government as one of the special economic zones where the opening policy could be best brought into play and new reforms are at the very first time tested. The role of the electronics industry was a focus from the very beginning of the special zone development in Shenzhen (GECC, 2002; SECC, 2004).

Initial industrialization is driven by the opening-up to foreign investment, especially from Hongkong owing to the locational advantage. Shenzhen was then the primary outlet to accommodate the transfer of small-scale and labor-intensive manufacturing facilities from Hongkong. Meanwhile, favorable policy for attracting foreign investment was designed to encourage large-scale programs with longer fund turnover periods, aiming to control short-term opportunist behavior of foreign firms.

The central government also adopted the strategy of embedding large-scale foreign investment with large domestic firms, including the large state-owned companies directly under the jurisdiction of state ministries and provinces, renowned universities and research institutes, as well as military-related plants that were highly specialized in heavy industry. These large joint ventures inherited the primary skill stock in the old national knowledge system in the planned economy and became the technological leader in Shenzhen at that time rather than the small “sanlai yibu” factories. They were then able to introduce high-scale production lines due to the disposal of state-owned assets and scale economies of production. Moreover, the high endowment of human capital in state-owned companies enables the better absorption of imported technology (SECC, 2004).

Besides joint venture with foreign companies, there were also joint ventures between domestic state-owned firms. The alliance among these state-owned companies was always accompanied by tasks of developing a specific leading product technology. In 1986, the Shenzhen Electronics Group Company (later Saige Group), which unifies 117 of the 178 companies in Shenzhen on a voluntary basis, was established under the approval of the Shenzhen City Government. In 1988, the Shenzhen Electronics Group Company arranged the construction of the first specialized electronic parts supply market in China, “Saige Electronics Supply Market”, which is a remarkable milestone in organizing the supply chain of the electronics industry in Shenzhen. Within this organizational arrangement, information and production opportunities are more frequently shared among member companies (SECC, 2004), and Saige Electronics Supply Market later serves as the breeding ground and incubators of entrepreneurship in Shenzhen.

Meanwhile, network governance has been formed in multi-level organizations, encompassing China Central Ministries, the Guangdong Province and the Shenzhen City Government and industrial park authorities in the aspects of initiating technology transfer, facilitating technological absorption for domestic firms and assisting the business sector in training, quality control and customer searching.

With the support of the coordinated state-led industrial policies and geographical proximity to Hong Kong, the electronics industry in Shenzhen has been developing rapidly, relying on processing operation in this period. Nevertheless, the industrial structure in electronics was concentrated in the standard consumer electronics industry (mainly telephone, TV, calculator and radio), which was faced with a saturated market and limited space of technological upgrading (SECC, 2004).

4.1.2 Governance at the turning point in 1990s

After 1990, the electronics industry in Shenzhen faced the rising factor price and gradually lost the technological advantage in consumer electronics compared to the other regions in China. In order to achieve successful upgrading towards high-tech electronics, the Shenzhen city government has strategically identified five industries: PC and software, telecommunication, microelectronics, optical-electro-mechanical integration and new materials. Under the guidance of the selected industries, foreign investment was supported around the five industry fields (SECC, 2004).

Besides adjusting the organizational competence to initiate the upgrading, the Shenzhen Government implemented two primary measures in terms of financing programs. Firstly, firms were offered the accessibility to capital markets, with the first capital market being formally opened in Shenzhen in 1992. More recently, the launches of the Small&Medium Enterprise Board (2006) and ChiNet (2009) have made Shenzhen the largest cluster of domestic private equity and venture capital investors.

Shenzhen's rapid development into one of the most important financial centers in China has greatly supported the local technological entrepreneurship and innovation activities of both small and large private firms. Secondly, the city government supported the small and medium-sized high-tech private firms with specific funding intermediaries (SECC, 2004), which has natured many private-owned technological leaders such as Huawei in Shenzhen.

"In 2002, half of the state-level 909 projects on integrated circuit design have located in Shenzhen and a cluster of integrated circuit design companies already took shape, which covers the operation of encapsulation, testing, plate making, device providing, scribing and thick film integrating. Among these firms, most of them are domestic firms such as Guowei, Huawei, Zhongxing, Aisikewei, etc. By the end of 2002, Intel and STMicroelectronics all followed and established research and design center of integrated circuit in Shenzhen." (SECC, 2004)

Owing to Shenzhen's special background as the experimental field for opening policies in China, private firms and privatization reform of state-owned firms were encouraged and supported by various levels of government. In 1993, Shenzhen's National People's Congress adopted the "Stock Limited Corporations Ordinance of Shenzhen Special Zone" and "Limited Liability Company Ordinance of Shenzhen Special Zone" with legislative power of special zones. Even in small and medium sized state-owned companies, employee stock ownership was gradually allowed. Under this circumstance, the human capital endowment was able to be released from the old national innovation system embedded in the 1980s-relocated state-owned companies, central ministries (Shenzhen Division) and research institutes (Shenzhen Division). Moreover, the favorable policy treatments in Shenzhen as attracted lots of talents across the country. The presence of high-qualified migrant talents, which do not own Shenzhen *hukou*, has resulted in a high level of entrepreneurial activities in Shenzhen,

enabling the exploitation of market opportunities from the foreign technology. As a result, many private firms flourished in the 1990s, establishing the base for a wide scope of interactive learning for innovation activities.

4.2 **Governance Evolution in Dongguan since the opening policy**

4.2.1 Governance in the initial phase of industrialization in 1980s

With the devolution of partial power of fiscal arrangements from the central government to town and village governments, the Dongguan local government has been enthusiastically devoted to economic growth. The industrialization process in Dongguan started in the garment and shoe industries during 1980s. Compensation trade, i.e. processing raw materials on clients' demands, assembling parts for the clients and process according to the clients' samples, expanded quickly in many villages and towns. The source of orders was mostly Hong Kong owing to the cultural proximity. At that time, there were about 650 thousand Dongguanese settled in Hong Kong. They worked or opened their own factories in Hong Kong and thereby were the mostly reliable communicators of business between Hong Kong and their hometown (Interview in Dongguan, September 2007).

The Dongguan local government put great focus on encouraging the Hong Kong-Dongguanese to invest in their home town. In 1981, the office of outward processing and assembly was established to organize this important task. Moreover, the village and town governments also greatly supported the development of compensation trade by offering cheap land, favorable policies and flexible standards. The distribution of the processing earnings is negotiated between the town and village governments and foreign investors, mostly under informal frameworks such as oral agreements (Interview in Dongguan, September 2007). In this way, vested interests are taking

shape among foreign firms, township and village governments, and peasants who live on the rent of the collectively owned land.

In the process of industrial development based on grassroots foreign investment attraction, infrastructure supply is directed to industry-specific and hands-on service mainly from the township and village governments, deploying the fiscal income into construction, such as factory buildings, roads, electricity and telecommunications, to improve the investment environment. This bottom-up industrialization process matched simultaneously with small-scale Hong Kong investment that feared institutional uncertainty. This leads to the scattered land use pattern and low agglomeration economy. Nevertheless, the demonstration effect of “successful small Hong Kong bosses” and the shaping of vested interests have further strengthened the governance focus on compensation trade in Dongguan.

4.2.2 Governance at the turning point in 1990s

By 1995, the profit space of garment industries was greatly shrinking. Electronics firms, mainly led by Taiwanese firms, along with some of the Shenzhen firms, were gradually relocating to Dongguan in the middle of the 1990s. The shift, attracted by low-cost factors in Dongguan, was systematically carried out through the clustering of Taiwanese firms with complex supplier linkages. Take Delta Electronics for an example, it has brought 22 small and medium sized upstream and downstream Taiwanese firms when investing in Dongguan. Relying on the networked production bought by Taiwanese firms, the electronics industrial chain is now complete and integrated in Dongguan with a kitting rate more than 95%. At the beginning of the 21st century, the compensation trade in electronics in Dongguan reached its peak. However, even before its accelerating phase in the mid 1990s, the policy focus at the provincial level on electronics development was specifically placed on Shenzhen, Guangzhou and

Foshan, rather than on Dongguan (GECC, 2002), pointing to its very grassroots way of development even in the electronics industry.

In order to attract large-scale high-tech investment in the face of industrial upgrading, the Dongguan City Government established the first city-level industrial park, with high entry standards, in 2001. Furthermore, the Dongguan City Government responded to the call from the central and provincial governments to evacuate the old low-end processing industries and attract new high-tech ones. However, this led to great resistance from the township and village governments. On the one hand, the township and village governments and the peasants rely heavily on processing firms for their major income (Yang, 2010). Therefore, vested interest has been firmly shaped from the bottom up, thus creating the inertia for structural change. On the other hand, the village and town governments not only lack the incentive, but also the experience to undertake far-sighted ex ante developmental arrangements and provide necessary infrastructure support in order to secure upgrading towards high value-added activities (Interview in Dongguan, September 2007).

"The profit of garment industry has been shrinking after 1995, and the development of electronics industry took pace. At that time, the bosses of medium-sized firms in Taiwan saw the huge profit made by the bosses of small-sized firms investing in Dongguan, and decided to follow in and establish plants here. However, the industry is without planning at all because Dongguan government, especially the town government, would offer land whenever the foreign firms are willing to invest. I remember that many surrounding towns and cities laughed at us on that, calling it 'there are so many stars in the sky in Dongguan but without a moon'."

——Own Interview with Dongguan Electronics Association President Ye in 2007

Due to the weak industrial base before the rapid development, the local skilled labor market and related industrial institutions remained underdeveloped, especially in face of great profit made too rapidly by compensation trade. Statistics in 2009 show that the

domestic sector is much weaker in Dongguan than that in Shenzhen (Table 6). This less endogenous development path and monotonous composition by foreign-owned low-end manufacturing facilities in Dongguan's business sector is expected to impact on the development of the regional innovation system in Dongguan.

Table 6 Statistics of the Domestic Sector in Shenzhen and Dongguan (2009)

Firm above scale*	Shenzhen	Dongguan
Share of domestic firm units	53%	25%
Share of domestic firms' output value	37%	16%
Share of domestic firms' added value	47%	15%

* firms above scale include all state-owned firms and firm with over five million sales

Source: Shenzhen Statistical Yearbook 2010 and Dongguan Statistical Yearbook 2010

4.3 **Summary of Governance in Shenzhen and Dongguan**

Shenzhen and Dongguan share many commonalities in the industrializing process. These two cities were all very underdeveloped regions with weak industrial based before the opening in 1978. The initial industrialization in both cities all heavily depends on foreign investment and excess supply of rural migrant workers all across the country supported by the *hukou* regime designed to control labor mobility.

Nevertheless, there are two underlying differences between the two cities:

The first difference is the locational advantage of Shenzhen being closer to Hongkong than Dongguan. This has given Shenzhen a first-mover advantage to take the transfer of manufacturing and processing facilities from Hongkong, with some less favorable activities such as garment and shoes washed out to Dongguan lying between Guangzhou and Shenzhen. Furthermore, this first-mover advantage to develop electronics industry has been strengthened by the second difference, i.e. the institutional advantage of Shenzhen over Dongguan.

From the above discussion, it can be seen that the development of the electronics industry in Shenzhen is strongly supported by active involvement of state authorities and organizations that simultaneously echoed with the trend of the global industrial shift of the electronics industry to low-cost regions in the 1980s (Luthje, 2004). Shenzhen's position as the vanguard of China's market-oriented reforms gives it the first-mover advantage in innovation-supported institution, incubating competitive and diversified firms in the business sector that pave way for the function of a regional innovation system. On the other hand, the institutional setup in Dongguan has repeatedly been strengthened for the aim of developing processing trade with the symbiotic monetary gain of the village and town level governments, small overseas Chinese investors (mainly Hong Kong and Taiwan) and local peasants. Moreover, the support of institutional organizations is mostly focused on enhancing the comparative advantage of the existing developmental mode of mass low-end production.

5 Discussion and Conclusion

Governance perspective towards regional development and innovation is characterized by supply-side support, which aims to provide supportive resources, secure collective actions and establish the strategic goals (Hausner, 1995). By comparing two cities from an evolutionary perspective, this paper finds that dirigiste governance modality in Shenzhen in the initial industrialization phase leads to a more mature and developed regional innovation system than the grassroots governance modality in Dongguan, although they both started the industrialization process in the wake of the opening policy in the late 1970s.

Insights from the empirical results show that dirigiste governance in the initial industrialization phase is more competent in providing innovation-related resources and guiding the developmental path with strategic intervention than the grassroots

governance, widening the scope of interactive learning and shaping the behavioral rationalities of firms to resort more to external complementary knowledge. While the newly recognized strand of grassroots governance supports its competency to mobilize the local resources and interdependencies (Amin, 2002), the result suggests a rather contrasting pattern, indicating that this approach in the initial phase of industrialization might lead to a negative lock-in effect in the face of restructuring and upgrading by restricting the firms within the repeated and narrow path of knowledge accumulation and generation.

As evolutionary investigation is subject to context, it should be remembered that the two cities in this study started the rapid industrialization process with a barren endowment of local skills and industrial base. The second unique context is that these two cities develop within a transitional context from planned economy to market economy, where old institutions and organizations have been constantly adjusted and destroyed while new ones have been constantly introduced and established. In this case, the grassroots approach tends to restrain the scope of development within the disposal of less competent local authorities, and the dirigiste approach is able to gain first-mover advantage over the grassroots one if the reforms are appropriate in general. Nevertheless, the empirical findings on the success of dirigiste governance in shaping innovative synergies among the firms should not be viewed as arguments favoring the central planning method of development in Keynesian legacy. In fact, its advantage is combined with the vital market mechanism that is released by many pilot implementation of market economy reform in Shenzhen as well as the market opportunity brought about by foreign investment, boosting a plurality of autonomous decision agents with respective strategic goals in the transition economy.

Grassroots governance in China has been widely applied since it was cost efficient for the central government and has actively mobilized the initiative of local governments to develop the economy. For clusters that developed out of grassroots governance in the early phase of industrialization for similar transition economies, two lessons can be learned to boost the development of the regional innovation system. Firstly, strategic planning of industrial development should be carried out to avoid negative lock-in, adjusting the developmental path to meet the changing market environment in time and identifying related new industries. Most importantly, levels of governance should be accordingly regulated and balanced to unfasten the vested interests aiming for contrasting development goals. Secondly, policy focus should be put upon enhancing the absorptive capacity of firms and related organizations, such as attracting high quality human capital and encouraging the conscious accumulation and development of technological capabilities within firms.

The comparative study between Shenzhen and Dongguan captures the governance modality in the initial industrialization phase and its evolution within transitional context as an important factor that leads to different degrees of regional innovation system development. As indicated by Cooke (2004, p.17), “regional innovation systems are evolving as their contextualization elements shift with globalization, the rise of knowledge-intensive industry and the hollowing-out of ‘Industrial Age’ industries”. Therefore, it would be useful to identify the elements of governance in relation to the business needs under the new market trends. Furthermore, more thought should be put into the question of how to keep the dynamics and prevent the inertia of governance modality in the face of necessary changes.

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